## *ARUNDO DONAX* IN CALIFORNIA

*Kent Nelson, DWR*

- *Arundo donax* (Giant reed, Giant Cane)
- Status: California Exotic Pest Plant Council List A-1.
- Most invasive and damaging, widespread; Considered noxious by the California Department of Fish and Game, County Flood Control Districts, but not officially listed as noxious.

It is said "a rose is a rose by any other name." Doesn't it follow that a grass should be a grass by any other name? Not so. Meet *Arundo donax*, otherwise known as giant reed, giant cane, giant bamboo, or "evil weed."

*Arundo donax* is a tall, perennial, bamboo-like grass in the Gramineae family that colonizes stream banks and other wet areas. It attains a height of up to 25 feet and once established forms large, continuous root masses. A single clump typically has hundreds of stems that grow close together and rapidly—several inches per day in spring and summer. It appears that plants in North America do not produce viable seed, and seedlings are not observed in the field. Population expansion here occurs through vegetative reproduction, either from underground rhizome extension of a colony or from plant fragments carried downstream, primarily during floods, to become rooted and form new clones (Else 1996). *Arundo* is often confused with *Phragmites* sp., a native California grass of smaller stature found in similar habitat.

*Arundo* is believed to have been imported to California from the Mediterranean by early Spanish settlers. People once used it for building material and as a rapidly growing barrier. Lore from the Sacramento-San Joaquin Delta has it that *Arundo* was planted on levee banks for stabilization and erosion control at the turn of the century. As many alien plants do, *Arundo* has escaped cultivation and reproduced itself until it is now out of control. *Arundo* has no effective competitors and is unpalatable. The dense, high growing plant quickly chokes and kills everything in its path. The result is a sea of "cane"—a single species, where there were once hundreds. One almost cannot enjoy a streamside hike in California's valleys and foothills without encountering robust stands of this weed.

*Arundo* has been the biggest problem in coastal river drainages of southern California, especially in the Santa Ana, Santa Margarita, Santa Clara, Tijuana, and other major and minor watersheds, where it sometimes occupies entire river channels from bank to bank (Jackson and others 1994). The Santa Ana River in southern California bears stark witness to the aggressive, dominant nature of *Arundo*, where 65% to 75% of the riparian floodplain has been overtaken. Fleets of helicopters armed with potent, systemic poisons "treat" the infestation at a tremendous cost.

*Arundo* occurs, to some degree, in nearly all regions of the state, and in Baja California, usually below 1,000 feet of elevation. *Arundo* has invaded central California river valleys in San Luis Obispo and Monterey counties, the San Francisco Bay area, in the Sacramento and San Joaquin River valleys, and is also increasing in the North Coast region (Dudley and Collins 1995). Although not presently considered a problem in California deserts, *Arundo* likely would survive in regularly watered areas of the lower elevation deserts, but does not appear to tolerate high elevation and continental environments where regular freezing occurs (Sunset 1967).

Soil tolerances are very broad, as *Arundo* is known from coarse sands to gravelly soil to heavy clays and river sediments. It grows best in well-drained soil with ample moisture, from freshwater to semi-saline soils at margins of brackish estuaries.

Wildlife that depend on the alders, cottonwoods, bays, willows, annuals, and open space lose their habitats and food sources when *Arundo* moves in. A poignant example of this dynamic is the relationship between the least Bell's vireo and *Arundo* in southern California's vanishing native riparian habitat. Jim Greaves cautions that many birds such as the least Bell's vireo are highly tenacious to a particular "territory" and will persist until there is almost nothing left of their habitat (J. Greaves, personal communication, see "Notes"). Jim speculates that the birds are moving into *Arundo* because there is nothing else available.

*Arundo* has other characteristics that earn it the moniker of "evil weed." *Arundo* has been shown to consume up to three times more water than native plants. *Arundo* is suspected of altering hydrological regimes and reducing groundwater availability by transpiring large amounts of water from semi-arid aquifers (Iverson 1994). This could be a death knell for native riparian plants that eke out a living along many of California's annual streams and creeks.

*Arundo* has also fueled spectacular infernos that have crisped hundreds of acres of mixed riparian habitat. *Arundo* loves fire; native riparian vegetation does not. Dense growths of *Arundo* present fire hazards, often near urbanized areas, more than doubling the available fuel for wildfires and promoting post-fire regeneration of even greater quantities of *Arundo* (Scott 1994; Frandsen and Jackson 1994). *Arundo* is quick to resprout with tremendous vigor, often nudging out adjacent willows and alders that are slower to recover. A single fire event can transform a mixed riparian stand to an *Arundo* forest in one or two seasons.

Historians believe that *Arundo* was introduced into California at least partly as a "natural" means to control erosion on streambanks and levees. It is ironic that the verdant stands of *Arundo* that line levees in the southern Delta now pose an unexpected threat to levee maintenance and flood fighting capability. *Arundo* thickets hide erosion that undermines the waterward toe of levees. When flood fighting is necessary, as recently witnessed during our recent El Niño winter, *Arundo* interferes with the installation of erosion control systems, such as the laying of protective plastic and sandbags.

Due to *Arundo*'s many negative environmental effects, biologists and land management professionals agree that this weed is a primary threat to the health of the streams and waterways of California. In response, forces are mustering to begin a long and expensive battle. State, federal and local government, non-profit environmental groups, and concerned citizens are beginning to coordinate statewide efforts to focus on *Arundo* control and eradication. Many of these groups go by the name "Team Arundo." These teams excel at reaching out to watershed groups, resource conservation districts, and private landowners to educate and assist them in controlling *Arundo*.

CALFED (1999) is focusing on non-native plant species as well. A goal of the Ecosystem Restoration Program Plan is to "reduce negative biological and economical impacts of established non-native species." Two objectives flow from this goal: (1) halt the introduction of invasive aquatic and terrestrial plants into central California and (2) focus control efforts on those introduced species for which control is most feasible and of greatest benefit. *Arundo* clearly falls within these guidelines. CALFED has also assembled a team of scientists to draft a comprehensive strategic plan and implementation plan targeting non-native invasive species. *Arundo* is a target species of these documents.

If several, pending, *Arundo*-focused, CALFED grant applications are approved, we are likely to see rapid strides forward in recognizing the scope of the infestation, and then developing comprehensive control and eradication strategies with a broad base of support.

For further information, access the CERES site at http://ceres.ca.gov/tadn/index.html.

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## NOTES

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## NEW VEGETATION SURVEY METHODOLOGY FOR THE SUISUN MARSH

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### INTRODUCTION

A new vegetation survey methodology has been developed to characterize the overall vegetation composition of the Suisun Marsh. This new methodology was developed by the California Department of Fish and Game (DFG) Habitat Conservation Division and reviewed and approved by the Suisun Marsh Preservation Agreement Environmental Coordination Advisory Team (ECAT) (DFG 1999). It will incorporate data from aerial photographs, satellite images, and field vegetation surveys into a geographic information system to create an accurate vegetation map of the marsh. The SMPA agencies are implementing this new methodology for the first time in Suisun Marsh during summer 1999.

### BACKGROUND

As part of the Suisun Marsh Preservation Agreement (SMPA) monitoring program, the California Department of Water Resources (DWR) conducted vegetation surveys conducted to better understand the overall vegetation composition of the Suisun Marsh, including habitat of the federal- and State-endangered salt marsh harvest mouse (SMHM) (*Reithrodontomys raviventris halicoetes*), using aerial photography in combination with ground verification. An initial vegetation survey was conducted in 1981 to provide a baseline for future vegetation surveys. Additional vegetation surveys were carried out in the Suisun Marsh in 1988, 1991, and 1994 to observe changes in vegetation composition over time.

In 1996, an interagency technical committee was convened to review the current survey methodology and recommended a more detailed monitoring system for vegetation changes within the marsh. The committee identified the following limitations: (1) the lack of useful maps from the 1988, 1991, and 1994 surveys; (2) the past methodology was not based on a habitat classification system such as that used in the California Wildlife Habitat Relationship System; and (3) use of inappropriate methods for calculating the acreages of each habitat type. Consequently, in July 1997, the committee agreed to implement a new survey methodology for the next vegetation survey.

Development of the new survey methodology was facilitated by the SMPA ECAT. The ECAT is a multiagency team formed to ensure compliance with mitigation and monitoring requirements of the SMPA, and to provide technical guidance and oversight of Suisun Marsh monitoring, management and restoration programs conducted as part of the SMPA. Participants in the ECAT include the US Bureau of Reclamation (USBR), DWR, DFG, US Fish and Wildlife Service, National Marine Fisheries Service, US Army Corps of Engineers, and Suisun Resource Conservation District. The new methodology was developed by DFG staff and reviewed and approved by ECAT members.

### SURVEY METHODOLOGY

The Suisun Marsh vegetation surveys were originally intended to answer specific questions required by permits and the SMPA. With new technology it is now possible to meet the original needs of the vegetation survey and fulfill additional data needs. This new methodology is based on work by DFG's Wildlife and Habitat Data Analysis Branch at Anza-Borrego Desert State Park, Point Reyes National Seashore, and the Mojave Desert. The proposed survey methodology is designed to document changes in preferred habitat for the SMHM, and gather vegetation data in such a way that it can be used for a variety of other purposes, including correlating management activities with vegetation changes, gathering data to support the use of a geographic information system (GIS) format, and creating a base vegetation map for future studies. By incorporating vegetation data into a GIS, it is possible to create a single vegetation map for the Suisun Marsh that provides an accurate characterization of vegetation types and acreages of each. The vegetation map and database will allow easy access to vegetation data, change detection, and determination of underlying influences of vegetation. It will also allow queries and overlaying additional information such as soil type and hydrology.

The vegetation map will be constructed through the interpretation of aerial photographs, field investigations, vegetation classification, and GIS processing. Vegetation throughout the project area will be sampled and characterized during field visits. Vegetation sampling and classification methods will be based on a Vegetation Sampling Protocol developed by the California Native Plant Society (CNPS) Vegetation Committee. The CNPS sampling method uses variable-sized relevé plots centered in representative vegetation stands based on aerial photograph delineations. The number of samples per vegetation stand are determined in the field and depend on the size and floristic variability of the stand, the time available to the field team, and the proximity of other stands of the same vegetation type. The percent cover for each species is estimated according to vegetation strata.

The DFG will analyze the survey data using hierarchical classification techniques to develop a vegetation classification that lists and describes the vegetation types within the project area. Polygons are assigned final vegetation attributes and transferred to the GIS through a process which involves digitizing vegetation polygons, georeferencing the data, and editing the data for quality control.

Additional opportunities of this new methodology will be trend analysis using annual aerial and satellite surveys, and a responsive means to determine the need for repeat surveys of Suisun Marsh. The monitoring agreement for the SMPA requires mapping the entire marsh every third year. As a result of the short-term inconsistency of both natural and non-natural disturbance patterns, it is likely that the justifications for resurvey will vary significantly from year to year. The new methodology enables a rapid assessment protocol conducted on a yearly basis to determine the need and timing for a complete field resurvey.

The rapid assessment protocol requires acquisition of aerial photographs and satellite imagery of the marsh annually, stressing phenological congruence (flown at the same growth stage every year). These photographs will be checked for the overall percent of polygon change by a trained photo-interpreter. Randomly selected polygons will be compared by observing new photos with overlays of the most recently produced map. If the percentage of polygons in the sample showing a major change is greater than a certain percent for any given year, or a certain cumulative percent for any given multiyear period then a complete resurvey will be conducted.

Under such a regime, resurvey could occur regularly after a major environmental disturbance over a period of years, or may not occur for several years during a stable phase. It is likely that additional information based on independent sampling of SMHM populations should be considered in the decision to resurvey. Based on consultation with biologists familiar with population dynamics of this species, a specific threshold could be developed. In addition, inquiries of land managers should be made to determine what, if any, land and water management shifts are expected to take place that may warrant resurvey.

### NEW SURVEY METHODOLOGY PRODUCTS

The products from this new vegetation survey will include the following:

- Complete and partial 7.5" US Geological Survey (USGS) Quadrangle hard copy vegetation maps.
- A color-coded legend with vegetation series and cross walks to other vegetation types.
- Digital files of each quadrangle map.
- Digital and hardcopy metadata.
- A final report including details of map accuracy, mapping methods and standards, a final listing of vegetation types mapped with an acreage summary, and a delineation of SMHM habitats. The report will also include recommendations for efficient remapping of the marsh.

This new methodology is being implemented in the 1999 Suisun Marsh vegetation survey, funded by DWR and USBR. Aerial photographs and satellite images of the marsh were taken in mid-June, and vegetation field surveys are expected to begin in mid-July. The DFG will dis-